

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently Amended): A control apparatus for controlling a control system having a transfer function regarded as a second order system, comprising:

an outer loop configured to execute a negative-feedback of an output scalar x  $[[x]]$  of the controlled system to obtain a deviation scalar e  $[[e]]$  between the output scalar x  $[[x]]$  and a desired value scalar r  $[[r]]$ ;

a first inner loop configured to execute a negative-feedback of a signal  $k_1 (dx/dt)$ , obtained by multiplying a gain  $k_1$  to a differentiated value  $(dx/dt)$  of the output scalar x  $[[x]]$  of the controlled system, to the deviation scalar e  $[[e]]$ ; and

a second inner loop configured to use the differentiated value  $(dx/dt)$  of the output  $x$  of the controlled system and a product, obtained by multiplying a gain  $k_2$  to an absolute value  $|e|$  of the deviation scalar e  $[[e]]$  or  $n$  powers ( ~~$n$ : integer~~) ( $n= 1, 2, 3, \dots$ ) of the absolute value  $|e|$ , to execute the positive feedback of a signal of  $k_2 (dx/dt) \cdot |e|$  or  $k_2 (dx/dt) \cdot |e|^n$  to the deviation scalar e  $[[e]]$ ,

wherein the controlled system is controlled using a signal which is fed back through the first and the second inner loops.

Claim 2 (Original): A control apparatus according to claim 1, wherein, when the controlled system includes a position control model, an adjusting element which changes the gain  $k_2$  to  $c / |r|$  or  $c / |r|^n$  based on the desired value scalar r  $[[r]]$  is provided.

Claim 3 (Original): A control apparatus according to claim 1, wherein a loop gain is inserted in the outer loop, when the controlled system has a transfer function with a proportional gain.

Claim 4 (Original): A control apparatus according to claim 1, wherein the gains  $k_1$  and  $k_2$  are set to values meeting the following equation of damping coefficients of a control system which are zero and positive:  $J+k_1-k_2|r| \geq 0$  or  $J+k_1-k_2|r|^n \geq 0$ , where  $J$  is a constant determined due to the controlled system with a secondary delay.

Claim 5 (Original): A control apparatus according to claim 4, wherein, when the controlled system is a position control model, an adjusting element which changes the gain  $k_2$  to  $c/|r|$  or  $c/|r|^n$  based on the desired value scalar  $r$   $[[r]]$  is provided.

Claim 6 (Original): A control apparatus according to claim 4, wherein, when the controlled system has a transfer function including a proportional gain, a loop gain is inserted in the outer loop.

Claim 7 (Original): A control apparatus comprising:  
an outer feedback loop which performs negative feedback of an output from a controlled system;  
a deviation computing unit which computes a deviation between a desired value and a controlled variable or output of the outer feedback loop;  
a first inner feedback loop which performs negative feedback of a product of a differential value of the controlled variable or speed and again;

a compensation unit which performs processing for canceling the deviation from the deviation computing unit by a compensation signal from the first inner feedback loop; and a second inner feedback loop which changes a damping coefficient of a control system according to the deviation from the deviation computing unit.

Claim 8 (Original): A control apparatus according to claim 7, wherein the controlled system includes a gain  $K$ , and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain  $K_f$  to perform feedback of the product.

Claim 9 (Currently Amended): A control apparatus according to claim 7, wherein the second inner feedback loop comprises a laplace operator which outputs a differential value of a controlled variable or speed of the controlled system, an absolute value computing element which computes an absolute value of the deviation obtained from the deviation computing element or  $n$ -th ( ~~$n=1, 2, 3, \dots$~~ ) ( $n=1, 2, 3, \dots$ ) power of the absolute value, a gain computing element which multiplies the computation output of the absolute value computing element with another gain, and a positive feedback element which performs positive feedback of a product of the output of the gain computing element and a differential value of the controlled variable or speed to the compensation element.

Claim 10 (Original): A control apparatus according to claim 9, wherein the controlled system includes a gain  $K$ , and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain  $K_f$  to perform feedback of the product.

Claim 11 (Original): A control apparatus according to claim 7, wherein the first inner feedback loop comprises a computing element having a laplace operator which takes out a differential output of the controlled variable or output of the controlled system, and a gain computing element which multiplies the differential output from the computing element by the gain to obtain the product.

Claim 12 (Original): A control apparatus according to claim 11, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain  $K_f$  to perform feedback of the product.

Claim 13 (Currently Amended): A control apparatus according to claim 11, wherein the second inner feedback loop comprises a laplace operator which outputs a differential value of a controlled variable or speed of the controlled system, an absolute value computing element which computes an absolute value of the deviation obtained from the deviation computing element or  $n$ -th ( ~~$n=1, 2, 3, \dots$~~ ) ( $n=1, 2, 3, \dots$ ) power of the absolute value, a gain computing element which multiplies the computation output of the absolute value computing element with another gain, and a positive feedback element which performs positive feedback of a product of the output of the gain computing element and a differential value of the controlled variable or speed to the compensation element.

Claim 14 (Original): A control apparatus according to claim 13, wherein the controlled system includes a gain K, and the outer feedback loop includes a gain computing element which multiplies the output of the controlled system by a loop gain  $K_f$  to perform feedback of the product.